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Plasma-induced crystallization of silicon nanoparticles[1] NICOLAAS KRAMER, REBECCA ANTHONY, MEENAKSHI MAMUNURU, ERAY AYDIL, UWE KORTSHAGEN, University of Minnesota — The ability to form crystalline group IV nanoparticles makes plasma synthesis an attractive production mechanism. However, temperatures that are significantly higher than the gas temperature are required for crystallization of these materials to occur. The nanoparticle heating mechanism therefore remains one of the poorly understood aspects of the plasma synthesis technique. In the current study, we investigate the crystallization of nanoparticles using a tandem plasma configuration, characterizing both the nanoparticles and the plasma. Amorphous silicon nanoparticles, 3-5 nm in diameter, are formed in a low-power upstream plasma and then injected directly into a separate secondary plasma which is operated with variable power. *Ex situ* characterization of the nanoparticles using X-ray diffraction, Raman spectroscopy and transmission electron microscopy showed that crystallization occurs at powers of 20 W to 40 W, depending on the nanoparticle size. The second step is an in-depth plasma characterization. We performed optical emission spectroscopy on the secondary plasma to obtain the electron temperature and hydrogen density, and capacitive probes for ion density measurements during nanoparticle crystallization. These plasma conditions are used in a nanoparticle heating model to simulate the nanoparticle heating in the second plasma. Calculations show that nanoparticles obtain temperatures much higher than the gas temperature.

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